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SUBJECT Soviet Progress in Electronics Equipment

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THIS IS UNEVALUATED INFORMATION 25X1

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A. General Assessment of Soviet Electronics Progress.

1. [redacted] although the German specialists were assigned, while in the USSR, a number of basic problems in electronics, some of which were claimed to be of very high security level, [redacted] never permitted to have all technical and operational information pertaining to these problems. [redacted] no access to other institutes dealing with similar, and in fact, the same problems. [redacted] not allowed to visit the Soviet production plants; neither [redacted] access to any classified Soviet files. [redacted] a series of highly specialized problems, and a number of [redacted] routine technical problems, and discussed these with Soviet engineers at all organizational levels, including the outstanding Soviet technical and scientific leaders, [redacted] never had access to the Soviet finished electronics equipment, have not seen them in testing or prototype use, and have not discussed their performance or operational data. [redacted] German equipment at a distance, such as the SCR-584, Meddo and Pauke, and recognized them because of [redacted] prior knowledge. [redacted] Germans, had good opportunities to compare our observations and interpret what [redacted] worked on. Thus, [redacted] strived to provide [redacted] with the technical and operational background necessary for our work and withheld by the Soviets. At times [redacted] able to check our conclusions against subsequent developments and against unguarded remarks by the Soviets. [redacted] this provided [redacted] a very good general picture of Soviet efforts and advances in the field of electronics. [redacted]

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25 YEAR RE-REVIEW

 [redacted] 25X1

[redacted] 25X1 a good deal of thinking and reading [redacted] general appraisal of the Soviet electronics progress is realistic [redacted] 25X1 it is based primarily upon [redacted] deductive and inductive reasoning.

2. At the end of World War II, [redacted] the Soviets started with 25X1 very weak, ineffective and spotty capabilities in virtually all branches of electronics--in radar, in navigation and guidance, in countermeasures, in vacuum tubes and other components and materials. They had good scientists, very capable leaders, and decent mechanics, but were extraordinarily weak in the middle class of engineers. The only exception to this might have been in the fields of communications and infrared where the Soviets believed themselves to be technically competent. This opinion was shared by such Soviet leaders as Admiral Berg, Captain Shchukin and others [redacted] 25X1

3. [redacted] immediately after the end of the war the Soviets recognized clearly the importance of electronics in military operations; that they were outrightly scared by the progress of the western nations, and particularly of the [redacted] in this field; 25X1 that they recognized clearly their own backwardness and the urgent need to remedy this. [redacted] they 25X1 decided to invest large-scale efforts in the buildup of their electronics capabilities and that they assigned to these a very high priority of national effort, perhaps second only to that assigned to atomic energy. Again, this was general knowledge among the Soviets and [redacted] these ideas expressed many times by 25X1 their best men. By a very realistic appraisal of their deficiencies and weaknesses; by a carefully developed plan for short and long-range actions; by a careful and painstaking exploitation of foreign techniques, facilities, methods and personnel; and, [redacted] very important, by a very capable 25X1 and effective management of their own resources and talents--the Soviets have been able, in less than ten years and starting with very little, to achieve an impressive record of electronic accomplishments, build up an effective and fast growing electronic potential and lay a firm foundation for a steadily expanding native competence. 25X1

4. [redacted] list some examples of [redacted] to be the 25X1 Soviets outstanding accomplishments in electronics:

(a) In radar technique the Soviets, without any direct assistance from the Germans, were able to copy and produce in impressive numbers the [redacted] SCR-584 radar, not a simple equipment, 25X1 as early as 1949/50 and were producing them in hundreds per 25X1 year thereafter; and to design and produce an airborne three cm radar similar to Meddo [redacted] 25X1

(b) In radar countermeasures or jamming the Soviets developed, in part by copying the [redacted] German practices and equipment, 25X1 but primarily by native efforts, good methods, techniques and high-power equipment, [redacted] perhaps not without some 25X1 foundation, that their radar countermeasure potential is one of the best in the world.

(c) In telecommunications they have completed new facilities and reconstructed and expanded facilities which had extensive wartime damage and in addition introduced the use of decimeter equipment and other modern techniques. They have developed a very large communication jamming capability against foreign propaganda broadcasts ([redacted] they had some 500 or more 25X1 jamming transmitters in the USSR).

 [redacted] 25X1

(d) In navigation, with the assistance of German specialists, they reviewed very carefully all navigational systems in operation and in development, and developed a system which is relatively free from jamming and which fits their basic requirements of accuracy and reliability.

(e) In high-frequency technique the Soviets have in general reached the competence of the West and were able to do original work [redacted] 25X1 (For example, they proved to be able to do a better job on millimeter waves than was done at Fryazino with our assistance.) They have been doing original work on very high power (of the order of 10 megawatts) high efficiency (80%) magnetrons and produced high power klystrons.

(f) Though in general the Soviets are behind [redacted] in 25X1 vacuum tubes, they have built a number of very large vacuum tube plants, increased their production output of common and specialized tubes many times beyond that of the end of the World War II days and managed to produce some troublesome tubes (such as AK-5) without much more trouble than has been experienced in the West.

(g) They have improved their educational program and with German assistance built extensive and effective on-the-job technical training facilities which permitted them to fill up their gaps in practical engineers, beginning sometime in 1950, and have developed a very effective management program for the use of their facilities, raw material resources and manpower.

5. [redacted] 25X1 in their opinion, the time of outright dependence of the USSR on foreign electronics science and technology, typical of the immediate post-war days, had passed and that the Soviets were ready and would stand on their own. [redacted] they would not exploit foreign developments, 25X1 even by outright copying, if this was to their benefit. [redacted] the Soviets reached the stage of scientific and technological maturity in electronics, and that they consider themselves competent to handle their own problems. It should always be kept in mind that the Soviets are determined to be self-sufficient in everything and although ready to use foreign efforts to their advantage they have a deep-seated distrust of foreigners.

6. [redacted] the great Soviet stress on electronics is conditioned by their concern with national security and more specifically with their military preparedness. [redacted] 25X1 "the Soviet people do not want war." [redacted] the driving force behind all Soviet activities, electronics including, is to get ready for war, and that the Soviets believe war to be inevitable. [redacted] 25X1 whether their concept of war is basically offensive or defensive. [redacted] from the words of Admiral Berg, Zuzmanovsky, and other 25X1 leaders, that during the immediate post-war years the Soviets stressed the defensive elements; that was the reason for the high priority on radar and communication jamming. There was a very definite shift, [redacted] in Soviet thinking from the concept 25X1 of local defense to the concept of long-range defense and finally to the concept of offense. [redacted] 25X1 Lt General Belyakov was responsible for the change in the highest priority in electronics from countermeasures (jamming) to navigation. [redacted] Russian history 25X1 preconditioned the Soviets to anticipate the need to trade space and manpower for time to build their defense. This is the basic

 25X1

[redacted]

reason for moving their strategic activities far inland (ie, Central Siberia and other distant areas) and making all their research and production institutes as nearly self-sufficient as possible. However, the last war taught them that it is offense that wins the war, and that a well-developed offense can perhaps remove or reduce the need for defense. They have been on the offense in "cold war"--they are apt to rely on offense in actual war. 25X1

7. In spite of the general advances in electronics, there are, [redacted] serious weaknesses in the Soviet electronic picture. One of these is the unbelievably low technological level of the large masses of people in the USSR. 25X1 Admiral Berg, with the assistance of Captain Shchukin and others, has been working hard to reach the Soviet masses by such popular-level Soviet publications as Radiotekhnika. In the USSR, however, even Radiotekhnika is high-brow stuff and Admiral Berg's efforts have barely scratched the surface. The masses are blissfully ignorant of the important role which technology as a whole, and electronics in particular, can have in the private life of the people [redacted] 25X1 And yet it is from these ignorant masses that the Soviets will have to draw the human material for their electronic specialists, and in case of war, for the low-level operating, maintenance and production personnel.

8. There is [redacted] a very large dissipation of highly qualified manpower in the USSR as the result of the Soviets' decision to make all their important research, development and production units fully self-sufficient and independent. 25X1 This might be an important factor in their defense plans, but it must lead to a large-scale duplication, overlapping and waste of specialists who could be assigned to more immediately productive duties.

9. There are also serious gaps in the Soviet substantive sections of electronics. Perhaps, one of the most important is the continued scarcity of scientific and technological instrumentation. The Soviets have never been strong in this field, and the high rate of their post-war scientific and technological expansion placed such a heavy demand on laboratory equipments and production testing and control devices that the Soviets have not been able to cope with it. This is the basic reason for the Soviet purchases of such equipment from abroad. [redacted] the Soviets will 25X1 continue to be dependent upon the West in this field for some time to come.

10. [redacted] the Soviets are weak at present in the field 25X1 of servo-technique. Though strong in the theory of telemetering and remote control, they systematically vetoed any German proposal for the use of servo-technique, [redacted] the 25X1 result of the lack of proper experience by Soviet electronics specialists with the use of the precision techniques in their field. The same observations apply to the Soviet lack of precision goniometers in navigational systems.

11. In spite of the strong interest of the Soviets in the advanced type of computers, the data handling procedures in the laboratories and [redacted] in production plants is also very primitive. At 25X1 Fryazino the only devices used by the engineers are slide rules, graphic charts (nomograms) and abacus.

B. Ultrasonic Developments.

12. [redacted] 25X1 familiar with only one Soviet project [redacted] might be concerned with ultrasonic

 [redacted] 25X1

uses. The project was concerned with "very small" equipment to be used in small boats. [redacted] 25X1 The project was started in Leningrad in 1949 and was returned to Leningrad in 1950, to a Navy laboratory. [redacted] 25X1 on possible application of the device other than it might be used as an echo-sounding fathometer to measure underwater profiles.

13. The operating frequency was 40 kilocycles/second; the peak power was to be 50 kilowatts. Nothing specific was known about the output load or output currents. [redacted] 25X1 The only significant condition was that the top of the pulse be flat within 10%. The normal pulse frequency was to be one pulse per second, the pulse ratio 1/30. The pulse characteristics were improved through the use of a choke in the screen grid circuit. The transmitter tube was pentode although originally Soviets tried a triode. The pentode was of rather large size, about five or six inches in diameter and 50 cm high. It was tested water-cooled, but worked air-cooled. The pentode was designed by a man in Leningrad.

C. Radar

14. Soviet development and production of "Meddo" ("blind bombing") radar has been concentrated at a large plant in Saratov. The three-cm magnetron presumably for this radar was first constructed at Fryazino and the klystron was designed in Leningrad. This latter information was gathered from Gerlach, who is a German klystron specialist, and a German master-mechanic, both of whom worked on klystrons in the USSR and were transferred to Leningrad to assist. Later everything on "Meddo" production, including the klystron and magnetron, seems to have been done at Saratov. Concerning aircraft sighting, [redacted] 25X1 The blister of the Western "Meddo" is very long and extends far below the aircraft fuselage. The Soviet bombers [redacted] 25X1 appeared to have a radome of about two square feet in dimension. The hood beneath the Soviet aircraft is believed to be too small to accommodate the normal "Meddo" antenna, [redacted] 25X1 the antenna of the Western "Meddo" had been modified or the Berlin-type antenna had been used. A Berlin antenna would just fit into this space. [redacted] 25X1

15. There were two Pauke radars in Germany during the last war for airborne gun-laying. One operated in the nine-ten cm region; the other in the 25-27 or 61-72 cm region. The nine-cm Pauke was the one in which the Soviets demonstrated interest. The Pauke had oscillating dishes and in a pursuit plane one probably would not work with these. The instruments for the pursuit aircraft should be with stationary dishes. The Pauke could thus be greatly simplified. [redacted] 25X1 the Soviets have worked on the Pauke very much. They are well acquainted with the problems of a modern fighter plane and its requirements. [redacted] 25X1 the Soviets do not have the Pauke [redacted] Korean operations and the lack of Soviet airborne fire power. [redacted] servo-techniques to be a weak point with the Soviets. The fact that the Soviets do not have the Pauke can only be due to the fact that they have been unable to produce it.

16. In 1946 the Soviets were very much interested in the Forsthaus, a German 10-cm Telefunken early warning development. [redacted] 25X1 It is possible, however, that the high-power magnetron development work in the 10-cm region [redacted] may be associated with such development. This is considered important work.

 [redacted] 25X1

17. [redacted] Soviet interest in early warning radar of wave lengths in the region above 12 cm (below 2500 Mc/s), such as, for example, the Forsthaus FK, operating in the 25-27 cm region. However, the Soviets had a very intense interest in tubes in the wave-length region between 1.5 meters and 40 cm. The development was supposed to be top secret and the German engineers were not supposed to hear about it. Some Germans were believed to have assisted in associated problems. The peak output powers reportedly sought were in the order of 10 megawatts [redacted] The probable application of such a tube development is radar or linear accelerators, with radar more likely. Only additional information bearing on possible early warning radar developments was the fact that Captain Shchukin in 1945 and 1946 was working on a study as to whether a system for aircraft detection at distances of 300-400 kilometers was feasible. 25X1 25X1

18. [redacted] contacts with Naval men were the following: [redacted] Captain-Professor Shchukin, co-editor of the Soviet scientific publication, Radiotekhnika [redacted] Shchukin is a professor in a Leningrad military technological institute for radio frequency work; he is a Navy Captain of Engineers [redacted] He always appeared in uniform in Germany and in civilian clothes in the USSR. He is probably active but not on sea duty, he is probably with some Engineering or Navy Bureau. He appeared to be particularly interested in "Brommy" and "Goliath." Also in 1946 [redacted] sUNCODEDer professors from the Technische Hochscule in Leningrad who all appeared in the uniform of Naval officers. For example, the head of the Technische Hochschule in Leningrad wore the uniform of a Vice-Admiral. [redacted] another professor in the uniform of a Rear-Admiral who came to Germany for about a week and who was the author of a very voluminous book on electronic tubes. [redacted] There were several projects on stabilizing the frequency of oscillators, one of which was clearly for the Navy, to stabilize frequencies on ships in the presence of large conductor masses such as funnels. 25X1 25X1 25X1 25X1 25X1 25X1

19. The Fryazino work was very theoretical and the Soviet oscillator stability specifications were one part in 10,000 for both 10 and three cm. The antenna rotation rate was to be one per second. [redacted] it was considered highly secret, and more than one ministry was interested in it. There were no requirements on the absolute stability of the receiver. Other applications surmised were beacons and guided missiles. [redacted] official liaison man was /fnu/ LUKOSHKOV, leader of the Theoretical Department at Fryazino. Orders came through him, and [redacted] reports went directly to the Council of the Ministry. In this case there were three or four ministries interested: Communications Equipment, Aeronautical Equipment, the Navy and an unknown fourth one. 25X1 25X1 25X1

20. In 1948 copies of the SCR-584 were made in Institute 108 [redacted] a complete SCR-584 at Dr Buschbeck's which may have been an original. [redacted] Zuzmanovsky [redacted] had finished about 16 installations. [redacted] they had some difficulties in reproducing the SCR-584. [redacted] a complete Soviet instrument, only the modulator. [redacted] a Moscow flak battery. [redacted] there were three pulse frequencies used with the Soviet set. [redacted] they were 1,000, 2,000, and 5,000, [redacted] 25X1

21. [redacted] 25X1

22. [redacted] no Soviet work on IFF or recognition equipment. The German FuG-25 or other foreign IFF equipment were not noted. 25X1

23. Malenkov was head of the radar committee in 1947, and his representative on the Committee was Admiral Berg of the Navy who was formerly on active duty but now retired. The radar committee was formed in 1947. The leading spirit on the committee was Captain Shchukin. A Major General UGIER also served as a scientific member of the committee. Another was a gentleman who worked as an organizer [redacted] Shchukin's secretary was also in Germany as well as 50 other advisers who were not members of the committee. Most of them were Svetlana people who had come to Germany to study tubes. There were no sub-committees. At times people came from the USSR who were interested in some special projects. They held somewhat lower ranks, usually Major or sometimes Captain (Army) who were to study special projects, for example, Forsthaus or Jamming. [redacted] Colonel Popov, A Deputy Minister of the Ministry of Communications Equipment, who was assigned to the radar committee but was not a member. After 1947, the Committee was disbanded and personnel under Shchukin were transferred to Committee number three of the Ministry of Communications Equipment. The planning was then carried out under the Ministry. The various interested parties, Army, Navy, AirForce, and Signal Communications had their tasks and projects co-ordinated in conjunction with the Ministry of Communications Equipment. There was no connection between the Committee number three [redacted] in Moscow. [redacted] 25X1

24. [redacted] Institute 20 is in the central southeastern part of the city. [redacted] of the number 108, Admiral Berg's institute. [redacted] 25X1 25X1 25X1

25. The development of tubes for eight millimeters began in Germany in 1946 for the Soviets. Then Captain Shchukin told [redacted] was working with 1.25 cm wave length. [redacted] the project for a klystron and magnetron for eight mm. These experiments came to an end in October 1946. [redacted] a klystron made in another institute near Moscow to test eight mm silicon detectors being made at Fryazino. [redacted] 25X1 25X1

26. [redacted] 25X1

 [redacted] 25X1

27. [redacted] 25X1

D. Guided Missiles.

28. [redacted]

29. The following is a summary [redacted] in regard to the Soviet work on guided missiles: 25X1

(a) [redacted] the Buschbeck group worked on the V-2 problems. [redacted]

(b) [redacted] the Buschbeck group is the best German group in the USSR on guided missiles with good scientific and technical capabilities. Formerly there was another group, the Askania group. [redacted] originally worked in Kuybishev, but left Kuybishev in 1950 and were divided in two parts--one went to work with Buschbeck and the other back to Germany; 25X1

(c) [redacted] the Buschbeck group was forced to sign a new four-year contract [redacted] this means that the Soviets expected to complete the work of this group and solve their guidance problems [redacted] This would permit the normal procedure of a cooling-off period of a year and then return the group to Germany. 25X1 25X1

(d) [redacted] the Soviets recognize clearly that for short-range guidance of a V-2 type missile, decimeter waves could be used, perhaps around 20 cm. For distances of several hundred miles or longer, meter waves must be used. 25X1

(e) [redacted] the comments of Buschbeck's associates, Germans and Soviets, that the Soviets consider the V-2 type of missile of utmost importance, because it is least subject to jamming; ie, it can be interfered with only during the immediate post-launching phase, thereafter it follows a ballistic trajectory without any guidance. 25X1

(f) [redacted] comments of Captain Shchukin [redacted] he was very much interested not only in the design aspects of missiles but also in electronics countermeasures against guidance, against terminal homing and missile fuzes. 25X1

(g) [redacted] the basic Soviet work on missiles is not done by the Germans, or by a German-Soviet group such as Buschbeck's, but by some Soviet organizations without any German participation. [redacted] that their work is concerned with the development of electronically-controlled guided missiles of the V-2 type. 25X1 25X1

(h) [redacted] the Soviets will be able to have a long-range semi-ballistic missile of V-2 type within 10 years. [redacted], the importance which the Soviets assign to guided missiles and their general progress in electronics [redacted] 25X1

 [redacted] 25X1

30. [redacted] 25X1

Buschbeck himself was very secretive and would not say anything about his work, problems or progress. His people were less restrained, but talked only in generalities or in regard to very minor technical details.

31. Originally, Buschbeck's group worked on V-2 techniques which were begun in Germany. [redacted] consulted by the Buschbeck group on special characteristics of vacuum tubes and detectors, particularly their performance at great heights--160 km. The problem was essentially that considered by the Germans in their V-2 work. Later, in Germany, [redacted] that work was done also in remote control problems, not in Moscow but in Heiligen [redacted] (one of the men from Heiligen See is now at Wetzlar). Also from conversations with Buschbeck [redacted] the basic problem handled by his group was that of missile control by the use of gyro devices. [redacted] the basic[a] work at the original guided missile institute in Moscow which burned down in 1949 was done on the essential problems which were initiated in Germany. 25X1 25X1 25X1 25X1 25X1

32. [redacted] Buschbeck, and from one of his specialist-engineers who was transferred to Fryazino that in 1948-49 the Soviets were not able to produce gyro instruments and all their experimental work was with [redacted] instruments acquired by the Soviets from the German war-time stock in Thueringen. [redacted] in 1949 the Soviets were not even able to copy the [redacted] gyros. 25X1 25X1 25X1 25X1 25X1

33. In electronic guidance, the initial Soviet work also followed the German trend. Two steps were used by the Germans in guidance development for V-2. One was the development of a guidance system, on a wave length of approximately six meters corresponding to the old German blind-landing system. The second phase was the development of Kogge 1 and Kogge 2 systems. [redacted] initially the Soviets were using this system, working around 17 cm, primarily because Buschbeck knew this system very well. 25X1

34. [redacted] the Soviet successful work in long-range navigational system operating in multi-meter range, might have induced them to apply this experience to their guidance of missiles, and to concentrate on long-wave electronics guidance or control in the multi-meter wave region. 25X1 25X1

35. [redacted] an SCR-584 radar used by the Buschbeck people in their missile development work. [redacted] automatic control of SCR-584's used by Buschbeck people was very good. 25X1 25X1 25X1

36. [redacted] work on a special high-precision cathode ray tube. [redacted] the work on this tube was still in experimental stages. [redacted] it was used, at that time, by the [redacted] 25X1 25X1 25X1 25X1 25X1

 [redacted] 25X1

Buschbeck group. [redacted] the tube work came 25X1
from ballistic specialists, especially the Soviet Navy and was
related to an invention of a Soviet Naval officer who worked on
it in Institute 160. Apparently, therefore, the interest in the
tube did not come originally from the guided missiles specialists.
[redacted] it may well be applicable, and perhaps 25X1
has been used, in the Soviet development work on the long-range
V-2 type of semi-ballistic missile.

E. Electronics Computer.

37. [redacted] the Soviet work on computers is that in 25X1
which Prof Gutenmacher was involved [redacted] 25X1
Gutenmacher is regarded by the Soviets as a high-quality computer
specialist. [redacted] Gutenmacher is considerably short of 25X1
being a genius, [redacted] the Soviets overestimate him. 25X1
Perhaps it is due to the fact that a computer specialist must
be both a mathematician and electronics specialist--a rare
combination in the USSR. Prof Gutenmacher is the only person [redacted] 25X1
[redacted] in the USSR who knows a little of both. 25X1

38. Gutenmacher's analog computer was built for the solution of a
system of linear differential equations up to the sixth order.
This computer was designed by Gutenmacher and built at Pensa.
There were perhaps no more than 10 of these by the end of 1951.
Of these, only three were in good working condition, one was
used by Gutenmacher, one was near Mytischi and one at Institute 160.
[redacted] It operated on a principle of condenser- 25X1
resistance discharge. The main problem was to obtain good
relays for the periodic short-circuiting of condensers. The
set of relays supplied originally were so unreliable that it
was nearly impossible to work with the equipment. [redacted] 25X1
[redacted] these be replaced by good relays produced in Leningrad, and 25X1
this made the computer useable. But, in fact, the computer was
not used. Its construction was good, but it had many design
weaknesses, [redacted] 25X1

39. [redacted] that Gutenmacher started (1951/52) work on the 25X1
development of a digital computer at his Moscow Institute.
This work is probably still /September 1953/ in the experimental
stage.

40. [redacted] designed an analog computer--an
electronic writer. [redacted]
[redacted] It was scheduled 25X1
for publication in the USSR, [redacted]
[redacted] the equipment was considered
too complicated, and most probably was not used.

41. [redacted] a series of 25X1
lectures on computers to the members of the Institute so that
they could learn the fundamentals of analog and digital computers.
[redacted] In spite of the fact that at 25X1
our institute there were good mathematicians and good electronics
engineers, and that they were well acquainted with the men [redacted] 25X1
[redacted] there appeared to be no appreciation 25X1
of the importance of computers in technological and scientific
work.

F. Electronic Navigation.

42. [redacted] immediately after the end of the war 25X1
the highest priority effort in the USSR was given to electronics
countermeasures, but that later this priority position was
shifted to long-range navigation. [redacted] this field of 25X1
Soviet endeavor still occupies the most important position in
Soviet electronics.

 [redacted] 25X1

43. The Soviets have an excellent team in the electronic navigation
field consisting of General Belyakov (who was the navigator of
the Soviet plane which flew over the North Pole) who is an
experienced flying officer, a very good administrator and man
of considerable vision and power, and Professor Stillermann,
General Belyakov's close assistant and the best Soviet naviga-
tional theoretician. They work [redacted] at an institute, 25X1
[redacted] located south-west of Shcholkovo 25X1
(there was a very large air field there). There is also another
place under Belyakov's control located at the Chkalov field
(Chkalov was the pilot of the North Pole flight).

44. The German group which [redacted] on electronic naviga- 25X1
tion consisted of Kotovsky, Kaufmann and Feussner. Kotovsky and
Kaufmann are high-quality technical leaders, Feussner is a
specialist in mechanical design. All three are somewhere in the
Leningrad area. [redacted] 25X1

45. [redacted] the theoretical basis for the Soviet approach to
long-range navigation was derived from a theoretical study
written by Professor Zinke [redacted] He undertook 25X1
(in 1945/46) some theoretical work regarding propagation of
electromagnetic waves. The by-product of his study was that
the effective ranges possible with long-wave, especially at
great distances, were much higher than was then generally
believed. As the result, [redacted] of this work, General 25X1
Belyakov, who visited Berlin, assigned to OSW, in May or June
of 1946, two basic design problems--(a) short wave cm system
for 300-500 km (on a long a range as possible) with an accuracy
of 50 meters (this [redacted] was for use with bombing 25X1
devices) and (b) a long-range navigational system with a range
of 2500 km and 5 km accuracy. Several conferences were held
with the Soviet specialists on the projects (at one meeting,
[redacted] in addition to other Soviet specialists, General 25X1
Belyakov and Vasily Stalin were present). Work on these
systems was not completed at OSW because of inadequate facilities.
But as an introductory step all then known navigational systems,
including the Western ones, were carefully reviewed and reassessed.

46. [redacted] in part as a result of slow progress at OSW, and 25X1
primarily because of the decision made around that time by the
Soviets to transfer all important work to the USSR, the study of
the navigational systems and the development work was taken
from OSW and assigned to the Soviet institutes under General
Belyakov. [redacted] a very thorough reassessment of the 25X1
world experience in navigation was undertaken there by the Soviets,
with some help from the Germans, and that decisions were reached
in regard to back a long-range system and a short-wave cm system.

47. [redacted] the Soviet final decisions were in regard to 25X1
technical characteristics of the adopted systems. [redacted] 25X1
discussions with the Soviets in 1945/46, and from subsequent
reports of the German specialists that the Soviets were not
interested in producing copies of the Western equipments but
wanted a new development approach to the problem. More specifically
[redacted] the Soviets were guided in general by the 25X1
following principles and goals:

(a) Short range system (decimeter)--The Soviets were concerned
with the basic problem: is it possible to develop a short-
range system which would work automatically with the
required accuracy? Prof Stillermann and a young assistant,
[redacted] studied this problem very 25X1
thoroughly. For example, this assistant asked [redacted] to 25X1

[redacted] 25X1

determine the effect of changes in the dielectric constant of the air. [redacted] at distances of 200 to 300 km error 25X1 due to this factor alone (if the dielectric constant is assumed to be constant) may be approximately 20 to 30 m. On this basis it would appear that some correction or calibration methods must be used by the system if the accuracy of 50 m is to be obtained (use of leading plane, photo reconnaissance, use of homing devices, etc). Other operating conditions were laid down by the Soviets. [redacted] 25X1 [redacted] doing the preliminary work at OSW 25X1 the Soviets required that 30 to 50 planes had to be given the opportunity to interrogate the ground stations and receive instructions without interference. Thus a system proposed then was different from that used [redacted] 25X1 during the last war, which claimed an accuracy of 50 m. The system used two receiver stations, the distance between which was known. The antennas were designed to rotate rapidly to eliminate the mutual interference between planes in the air. [redacted] what happened to this proposal 25X1 or what final system the Soviets decided upon.

(b) Long-Range System--The basic Soviet requirements initially formulated by the Soviets in 1945/46 for OSW were: range--2,500 km or more; accuracy--5 km or better, operationally reliable under diverse propagation conditions, freedom from jamming and ability to handle air traffic. [redacted] 25X1 quantitative measure of the requirement in regard to traffic or operational reliability. [redacted] (the Soviets postulated that the range of the new system should be at least double of that for Loran with the accuracy of 5 km), Decca, which was judged to be preferable if a large number of planes were to be guided to a large number of different airfields and VOR systems which were believed better for air traffic with relatively few landing fields. As a result the system proposed was to operate in the frequency range around 2,000 m on a short-duration pulse phase-comparison basis with a peak power of the order of a megawatt (which was recognized to be no serious problem). The system was to use two ground stations against three used in Loran. There was some talk of super-imposing a medium-frequency (10-20 meters?) system upon the basic 2,000 m system. [redacted] An original 25X1 antenna for this long-range system was designed by Dr Hasselbeck in Berlin. The antenna, of a table model type, was tested with cm waves.

G. Soviet Telecommunications.

48. [redacted] 25X1 [redacted] (a) relatively high competence of the Soviets in 25X1 this field, perhaps the only section of electronics in which the Soviets did not consider themselves backward at the end of the war and thus did not face the need of intense new post-war development and (b) perhaps a corollary to the above, very few telecommunication problems were assigned to the Germans. [redacted] 25X1 [redacted] the generally better situation in Soviet tele- 25X1 communications is due to the fact that research and development in telecommunications was handled before the war by the Svetlana group, consisting of the best Soviet engineers and undoubtedly very able by any standard.

49. [redacted] know very little about the Soviet activities in the general field of propagation and ionospherics. [redacted] they studied very carefully the world literature on the subject and [redacted] the Soviets carried out special studies in the field of propagation and ionospheric disturbances to determine what special techniques might be necessary to cope with the many varied atmospheric conditions of their country. [redacted] two Soviet organizations deal with such matters: the Postal Department of Telecommunication Services, and MGB. 25X1 25X1 25X1 25X1

50. [redacted] Lippsmann's work on E-channel systems.7 The problem was handled on a competitive basis between Lippsmann, of Institute 20, and the Institute at Mytischi. Apparently Lippsmann won, and received 100,000 rubles for his work. [redacted] the wave lengths of the order of 50/60 cm were considered. [redacted] Lippsmann did some theoretical work which lead him to the conclusion that the maximum number of channels he could use in a pulse-position modulation is 36. [redacted] Mytischi people were of the opinion that a centimeter antenna of ±10% tuning range was a difficult enough job and they were not interested in going any further. 25X1 25X1 25X1

51. [redacted] from reading Soviet papers and talking to Soviets and other Germans, that much consideration was given by the Soviets to the relative advantages of radio versus wire systems. More specifically, there was much discussion about a coaxial versus radio relay system for use between Kharkov and Moscow, and the discussions involved considerations of the overall performance of such systems for a 6,000 km span. Concurrently additional wire circuits were discussed for a Moscow-Vladivostok line, but not using coaxial cables [redacted] there was a special department at OSW which handled carrier systems development for the Soviets, and some of the German specialists in this field went to the USSR later. [redacted] Soviets were working on special coaxial cables in centimeter and decimeter wave region, but that was perhaps in connection with radar technique. Since hardly any one in the USSR but government officials uses long-distance circuits, and there is only one private telephone line in the USSR, [redacted] why they need to be concerned with wide-band systems such as presently used on coaxial cables. [redacted] Soviets have coaxial systems and are presumably building coaxial cables. 25X1 25X1 25X1 25X1 25X1

52. [redacted] German engineers worked, under the general supervision of MGB personnel, on small lightweight portable transmitters. These were used perhaps in Korea. These small transmitters were to be left at strategic points and could be operated from a distance to permit finding their location. 25X1

53. [redacted] the Soviets were intensely interested in very low frequencies for communication with submarines. [redacted] Captain Shchukin that the basic principle of communications with a submerged submarine was well known to them in 1946 and 25X1

 [redacted] 25X1

that they were able to carry on such communications before 1946 with a submarine submerged to the depth which left the tip of the antenna no lower than four meters below the surface. As a matter of fact, [redacted] Captain Shchukin claimed that 25X1 the Soviets did this before the end of the war. [redacted] 25X1 [redacted] Soviet interest in "Goliath" and "Marius" was primarily 25X1 due to the fact that these gave them additional transmitting facilities. Some questions came up in 1951 in Fryazino regarding the reproduction of tubes for the "Marius" transmitter. It is possible that the transmitter is in regular use now /September 1953/. The Soviet interest in "Goliath," [redacted] 25X1 was due to special construction of its antenna which reduced the earth resistance of the antenna to 1/3 ohm.

54. The Soviets were very active in broadcast jamming. [redacted] 25X1 they might have 500 or more jamming transmitters. In this connection [redacted] in Fryazino and in other places 25X1 around Moscow, the Soviets have a very large number of communications antennae ("antenna forests"), the size of which exceeds anything [redacted] in Germany, [redacted] 25X1

55. It is interesting that although the Soviets are very active in jamming foreign broadcasts they permit their engineers and mechanics to build their own radio receiving sets without any restriction on frequency coverage. As a matter of fact they sponsor and assist such activity. [redacted] at Fryazino the 25X1 Soviet engineers and mechanics were permitted and encouraged to draw upon some stock materials and components to build radio receivers and transmitters at home, [redacted] one mechanic 25X1 even managed to build himself a television receiver.

56. There are three televisions stations in the USSR: in Moscow, Leningrad and Kiev. The programs, [redacted] are of good 25X1 quality. [redacted] each station has its own radio station 25X1 and that the systems are not inter-connected by cables or other methods. A few television receiving antennas were seen around Moscow and Fryazino. All were of the simple dipole type--no elaborate antennas were noted for such reception.

H. <u>Proximity Fuzes.</u>

57. [redacted] 25X1 the Soviets were not producing subminiature tubes for use in proximity fuzes and had no proximity fuzes. [redacted] Captain Shchukin was very much interested in countermeasures against proximity fuzes; that as early as 1945 he had subminiature type tubes and was much interested in having these copied; and that Institute 160 made no copies of subminiature tubes, although it was given a job, in 1949 or early 1950, to build special production equipment for such tubes.

58. [redacted] some thinking and talking to other Germans returned 25X1 from the USSR, [redacted] Soviets 25X1 have been producing both the subminiature tubes and some proximity fuzes at Kalinin. [redacted] the Kalinin plant was 25X1 ready for production in 1949/50 and that it handled only specialized subminiature tubes and associated equipment*. [redacted] 25X1 [redacted] the manufacture of subminiature parts for 25X1

[redacted] 25X1

proximity fuzes makes sense only if large quantities can be produced. The quality production of large numbers of tubes requires good engineers. [redacted] Major Cheletnin 25X1 is such an engineer with experience in this field, but even more important he is a good leader and excellent organizer. [redacted] 25X1 [redacted] the matter of subminiature tubes 25X1 and proximity fuzes were discussed with German specialists up to about the time the Kalinin plant was ready for production. [redacted] 25X1 Germans being approached on the matter of subminiature tubes or proximity fuzes. [redacted] sometime in 1950 25X1 the Soviets might have reached the position of being able to handle the whole matter themselves.

I. Electronic Countermeasures.

59. [redacted] 25X1 Receivers between three and 40 cms are under development. The band between three and 10 cms was covered with different pieces of apparatus. The band was covered without gaps. [redacted] the steps cannot effectively be made much 25X1 wider than 10% plus and minus due to limitations of the antenna. Down to 40 cm detector-video sets are used, below that wave length tunable. [redacted] 25X1 [redacted] at the higher frequencies parabolas were used, and at the 25X1 lower frequencies several element dipole arrays. The tunable equipment at wave lengths longer than 40 cm is believed to have a preamplifier ahead of the mixer. [redacted] the Brommy 25X1 type array was ever considered at these radar frequencies. [redacted] 25X1 [redacted] the application of such devices is principally for 25X1 ground use, not special equipment for the Navy or the Air Force. [redacted] 25X1 the MGB makes such equipment because they are responsible for radio monitoring and radar surveillance. [redacted] 25X1

60. [redacted] information on Wullenweber development was gathered in part 25X1 by discussion in the USSR from time to time with Germans of the appropriate group. [redacted] 25X1 [redacted] The antenna array was an exact copy of the German World War II array. Work commenced at OSW and the MGB later continued with it. The array for Musa consists of a wide circle of approximately 50 individual antennas; Brommy has been used in this connection for observation of short duration signals. The receiver input mixers, i-f amplifiers, oscilloscope were the same as in Germany. The Soviets have completed one such installation built by the Germans covering 15 to 90 meters wave lengths and another is planned to be built by the Soviets themselves covering higher frequencies from 7.5 to 15 meters. The higher frequency system was to use the same type of array in appropriate scale. [redacted] 25X1 The location of the existing Wullenweber was near Moscow but its exact location was top secret. It was probably east of Moscow in the direction of the Gorky railroad, but this is only an assumption. The MGB sponsored this development; it is hard to differentiate MGB from military personnel since MGB men usually work in uniform. [redacted] 25X1 UNC [redacted] Both the Navy and the police are interested in this kind of development. It is probably designed both for protection against illegal transmissions within their country and intercept of external transmissions. The short

 [redacted] 25X1

signal requirement placed upon Brommy was 10 milliseconds. [redacted] 25X1 [redacted] other d-f development is from conversations 25X1 with Mr Rehbock. The Soviets believed that Brommy was too expensive and too complicated and it would be better to install a large number of Adcocks and to work with them. [redacted] 25X1 [redacted] the rotating goniometers used with such devices, 25X1 the communications between d-f installations, or other details or methods to extend baselines or improve accuracies and speed of high-frequency direction-finders. Schuettloeffel and Rehbock should have more data. Rehbock very likely will come West, but Schuettloeffel will probably remain in East Germany.

61. The production rate of the 500-600 watt tunable magnetron at 10 cm is some hundreds a month. [redacted] 25X1 [redacted]. The 25X1 klystrons are all labelled with their wave-band after a K prefix. The designation for the magnetrons are similar. Concerning future plans the Soviets wanted greater output and wider bands of energy; this they discussed frequently. The first plan for a tunable magnetron was to make it continuously variable over a band, a technique which is easy for the Germans. However, for the Soviets this was too complicated and they changed to four steps. Much work was done on this. The band of coverage was about 9.0 - 10.5 cm.

62. The tunable intercept receiver has a sensitivity of 4 KT at 40 cm. This is not considered unusual. The amplifier must have a small noise factor in relation to the mixer. Such values are obtainable with careful engineering work. Concerning sensitivity of the radar intercept devices at other wave lengths, [redacted] 25X1 [redacted] from three to 10 cm it is very poor; beginning 25X1 at 10 cm it is fair. At wave lengths longer than 40 cm it is believed of comparable value to that listed at 40 cm.

63. [redacted] 25X1

64. The Soviets wanted the Germans to develop wide frequency tunable receivers down to 2.5 cm. They approached the problem in the laboratory by use of a system which was part of a wave guide controlled by plungers to change the frequency. The work progressed sufficiently far to permit someone to use it. [redacted] 25X1 [redacted] It was still only laboratory work 25X1 but the reason for it was quite clear. The Germans call this a "Panorama" receiver and it is applicable not only to laboratory use but to radar observation. The shortest wave lengths of such work [redacted] were 2.5 cm. The tuning ratio was only 25X1 1.6 or 1.7 because at greater ratios the wave guide must be changed due to false modes. The limit of 1.7 applies to wave lengths below six cm. When concentric cables can be used, tuning ratios of two or three to one are possible.

[redacted] 25X1

25X1

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